Environment Canada Environnement Canada

Prince Edward Island Environment, Energy and Forestry

# Pesticide Monitoring in *Prince Edward Island*

**Prince Edward Island has a unique set of challenges when it comes to pesticide use. One of the most densely populated province in Canada, PEI has more than 250 watersheds and relies on groundwater as the sole source of drinking water. Its soils are highly permeable and susceptible to erosion. At the same time, agriculture is one of the key industries that fuels the economy, and pesticides play an important role in protecting crops.**

**The Governments of Canada and Prince Edward Island continue to work in cooperation with the agricultural community to reduce risks associated with pesticide use. Research and monitoring are an important part of that work. In 2003, the PEI Department of Environment, Energy and Forestry and Environment Canada began expanded pesticide research and monitoring programs, the most comprehensive regional programs of their kind to date. The monitoring part of the six-year program measured pesticide residues in groundwater, surface water, sediment, air, and in finfish and shellfish. This technical sheet includes a summary of the six-year pesticide monitoring program in Prince Edward Island. The research part of the program evaluated both the environmental risks associated with pesticide use and methods to reduce risks. A separate summary of the pesticide research program is available.**

**Similar research and monitoring activities are being carried out across Canada as part of a National Master Program for Pesticide Water Quality Surveillance supported by Environment Canada's Pesticide Science Fund.**

## GROUNDWATER MONITORING

### Highlights

Water samples collected for the groundwater monitoring program were taken from private homes, municipal wells, schools, seniors' housing and hospitals across the province, and from household wells in an area of intensive agricultural production. The results were compared against Canadian or American drinking water guidelines. Over the course of the three-year program, detections of pesticides in groundwater were relatively rare. Where pesticides were detected, the concentrations were quite low in comparison to drinking water guidelines established to protect human health. Atrazine, a herbicide often used on corn, was the most commonly detected product, and the one for which concentrations were highest.

The number of pesticide detections increased each year. However, this may be partly explained by improvements in the laboratory analysis. The lab was able to detect pesticide products at much lower concentrations in 2004 and 2005, compared to 2003. It is difficult, therefore, to compare results from year to year. While the monitoring period was not long enough to determine whether there were any trends in the frequency or location of detections, the fact that there are detections of some pesticides in the source of PEI drinking water demonstrate the importance of continued monitoring.

Canada

## Overview of Results

There were 104, 107 and 103 groundwater samples collected in 2003, 2004 and 2005, respectively. Samples were analyzed for 25 commonly used pesticides. Accordingly, about 2,600 individual analyses were completed each year.

### 2003 Results

There were four pesticide detections in 2003. Low concentrations of chlorothalonil, a fungicide used widely on potatoes to protect against blight (removed "and moulds"), were found in two wells. When the wells were retested, no chlorothalonil residue was detected. There is no *Canadian Drinking Water Quality Guideline* for chlorothalonil. However, Health Canada has provided a health guidance value of 70 parts per billion (ppb). At 0.1 and 0.4 ppb, the detections were well below this level.

Hexazinone, a herbicide that is used on blueberries, was detected in one well at a concentration of 0.7 ppb. Again, there is no *Canadian Drinking Water Quality Guideline* for hexazinone, but the *United States Health Advisory Level* is 400 ppb. There was also one detection of atrazine. It was detected at a concentration of 1.1 ppb. The *Canadian Drinking Water Quality Guideline* for atrazine is 5 ppb. Both hexazinone and atrazine have previously been detected in groundwater in PEI at concentrations below their drinking water guidelines. They belong to the triazine family of products and are among the most frequently detected pesticides in both surface and groundwater world-wide.

### 2004 Results

There were nine pesticide detections in 2004. Atrazine was the most commonly detected product. It was found in five samples, with the highest concentration being 0.81 ppb. Hexazinone was found in one sample at a concentration of 0.56 ppb. There were also two detections of metribuzin and a single detection of metalaxyl. Metribuzin is a herbicide and metalaxyl is a fungicide. Both products are commonly used on potatoes. The highest concentration of metribuzin was 0.18 ppb, well below the Canadian Drinking Water Guideline of 80 ppb. Metalaxyl was found at a level of 0.03 ppb. There is no *Canadian Drinking Water Guideline* for metalaxyl, however Health Canada has provided a guidance value of 500 ppb. Both metribuzin and metalaxyl have previously been detected in groundwater in PEI at concentrations below their drinking water guidelines.

### 2005 Results

There were 16 pesticide detections in 2005. Five of the detections were for atrazine, with the highest concentration being 0.65 ppb. There were seven detections of metalaxyl, with the maximum concentration 0.07 ppb; three detections of metribuzin with the highest concentration being 0.47; and a single detection of hexazinone at a level of 0.51 ppb.

**Summary of Groundwater Results 2003 – 2005**

| Compound | Detections (out of a total of 314 samples) | Maximum Concentration (ppb) | Drinking Water Guideline (ppb) |
|---|---|---|---|
| Atrazine | 11 | 1.1 | 5 |
| Metribuzin | 5 | 0.47 | 80 |
| Hexazinone | 3 | 0.7 | 400* |
| Chlorothalonil | 2 | 0.4 | 70** |
| Metalaxyl | 8 | 0.1 | 500** |

**United States Health Advisory Level*

***Guidance value provided by Health Canada*

# SURFACE WATER MONITORING

## Highlights

Samples collected as part of the surface water monitoring were analyzed for 25 commonly used agricultural pesticides. The results were compared against the *Canadian Water Quality Guidelines for the Protection of Aquatic Life,* when they were available for a particular pesticide. When Canadian guidelines were not available, measured values were compared with guidelines or action concentrations from other countries.

In many of the water samples collected, there are high amounts of suspended sediment particles caused by runoff from fields. It is known that some pesticides easily attach to sediment particles. However, it is not well understood at this time how the relative toxicity to aquatic organisms of pesticides to attached particles compared with those dissolved in water.

In addition, high amounts of sediment in water was not a key consideration when Canadian water quality guidelines were created. As a result, there is difficulty comparing the PEI surface water results to Canadian water quality guidelines. (This paragraph was moved up) However, comparing the data collected from water samples against Canadian water quality guidelines is still useful. By making this comparison, we know that water sample data that contain pesticide residues below guidelines are unlikely to cause toxicity, and those samples containing pesticide residues above water guidelines require further investigation.

The fungicide chlorothalonil was the only product found at a level above its Canadian guideline value. When pesticide concentrations are detected above their *Canadian Water Quality Guideline for the Protection of Aquatic Life,* they represent a potential risk to the aquatic environment. The guidelines are designed to protect all forms of aquatic life and all aspects of aquatic life cycles, including the most sensitive life stages of the most sensitive species. Therefore, even if severe impacts – such as fish kills – are not seen, if a product is detected above its guideline value, there may be more subtle impacts to aquatic life.

There are no Canadian guidelines for hexazinone, however this pesticide was found to exceed a water quality target established by Germany. The German targets are derived in a manner similar to the Canadian guidelines. Pesticide detections above the quality target represent a potential risk to the aquatic environment.

## Overview of Results

### 2003

In 2003, 27 samples were collected from the Mill, Wilmot and Souris River systems during both dry and wet weather conditions, from areas with significant row crop production in the watershed upstream of the sampling site. There were a total of 12 detections of five different pesticides. Chlorothalonil was detected in one sample from the Wilmot River at a concentration of 0.64 ppb, close to four times the Canadian guideline value of 0.18 ppb. Other products found in surface water samples at concentrations below their Canadian guideline values were the herbicide metribuzin and carbofuran, an insecticide used mostly on potatoes.

Two other products were detected for which there are no Canadian guidelines: the herbicide hexazinone and the fungicide metalaxyl. Hexazinone was measured in four of the nine samples collected from the Souris River. In the absence of a Canadian guideline, the results were compared against a water quality target established by Germany. All detections (0.08, 0.12, 0.24 and 0.16 ppb) exceeded the target of 0.07 ppb. Metalaxyl was detected in four samples from the Wilmot River with the maximum level being 0.14 ppb, well below a biological protection benchmark of 374 ppb proposed for Canadian aquatic systems.

### 2004

In the second year of the monitoring program, the sampling locations were changed to provide a broader picture of pesticide residues in different watersheds across the province. There was also greater emphasis on collecting samples after periods of rainfall and fewer dry-weather samples were collected.

A total of 15 samples were collected from the Wilmot, Founds and Montague River systems in the 2004 sampling program. Two pesticides were detected – both from a single sample from the Founds River system in the Granville area. The fungicide chlorothalonil was detected at a concentration of 7.83 ppb, well above its guideline value of 0.18 ppb; and carbofuran was detected at 0.59 ppb, about one-third of the guideline value of 1.8 ppb. The sample was collected after two days of heavy rainfall, which led to extensive surface water runoff.

**2005**

In 2005, monitoring was concentrated on the Wilmot River and on the North Brook tributary to the Dunk River. Both sampling sites were equipped with automatic samplers, which took water samples when there was rainfall of five millimetres or more in one hour. A total of 40 samples were taken during three rain events at the Wilmot River site and five events on North Brook. There were no pesticide detections in any of the samples collected.

## SEDIMENT MONITORING

Sediment samples, collected from streams at the same time and location as the surface water samples, were analyzed for 14 commonly used pesticides. In 2003, there were a total of nine detections of three insecticides – permethrin, azinphos-methyl and cypermethrin – in sediment samples from Mill River and Souris River. In 2004, dithiocarbamates were found at low concentrations in three samples from the Wilmot River and five samples from the Founds River. The dithiocarbamate (moneb and mancozeb) analysis detects a total concentration of a number of compounds within this chemical family, including the potato fungicide mancozeb. In 2005, dithiocarbamates were measured in all four samples collected from the Wilmot River and in all five samples from North Brook.

While some of the results for permethrin, azinphos-methyl and cypermethrin was above the only national guideline (Netherlands) that could be found for these compounds, there are no Canadian sediment quality guidelines for the pesticides detected. This monitoring is being conducted to investigate any trends and to direct appropriate follow-up studies in order to further assess the risks of pesticides in sediments.

In this study, the values for azinphos-methyl, cypermethrin and permethrin indicate the potential for risk to the aquatic insect communities in the watercourses studied. These results demonstrate the need for the development of more sediment quality guidelines in Canada, as well as expanded research on the impact of pesticide products on insects and other aquatic life in or on streambeds.

## FINFISH AND SHELLFISH MONITORING

This program marks the first time that there has been comprehensive monitoring for pesticide residues in fish and shellfish in Atlantic Canada. Brook trout, blue mussels and soft-shell clams were collected from the same river systems where the surface water monitoring was carried out. The samples were collected following rainfall events and analyzed for 14 commonly used pesticide products. There were no pesticide detections in any of the finfish or shellfish samples over the three-year program.

## AMBIENT AIR MONITORING

**As part of** a national pesticide air sampling campaign ((Removed "called" the Canadian Atmospheric Network for Currently Used Pesticides), ambient air monitoring was also undertaken. Eight sites were established across Canada, including one site in Kensington, PEI. Weekly composite air samples were collected at the Kensington site during the July to September periods of 2003 (five samples), and 2004 (eight samples).

In the 2003 testing, 10 herbicides and one insecticide were selected for analyses based on national use patterns. However, these pesticide products are used much more extensively in other regions of the country than in PEI. Despite this fact, there were three detections of ethalfluralin, two low-level detections of trifluralin, and one detection of atrazine. These products are all herbicides used on vegetable crops. Additional analyses were conducted on the 2003 air samples for pesticide products that are more commonly used in PEI. This revealed detections of the insecticides carbofuran and endosulfan, and the fungicides chlorothalonil and metalaxyl.

In 2004, a total of 42 pesticide active ingredients were detected in the eight samples collected. Similar to 2003, chlorothalonil, endosulfan and carbofuran, among other products, were detected in 2004. Most of the products were detected at low concentrations – at or near analytical detection limits.

In the absence of Canadian pesticide air quality guidelines, the monitoring results were compared to available US and European standards. In all cases, the measured concentrations of pesticides were well below these guidelines. Many of the pesticides detected are used in PEI. However, several of the products detected, such as chlordane and lindane, have not been used in this region for several years. This would indicate that these pesticides are being carried to this area in the atmosphere from outside the province. It should be noted that these data represent background or every day exposure and are not reflective of short-term exposures near fields actively being sprayed.

Precipitation samples were also collected and analyzed in both 2003 and 2004. There was a single detection of chlorothalonil in 2003 in the limited analysis conducted. In 2004, a total of 23 pesticide active ingredients were measured in the samples collected. Some of the products detected included 2,4-D; endosulfan; azinphos-methyl; chlorpyrifos; and phosmet. There are no guidelines available against which to evaluate the environmental or public health significance of these detections. However, because the concentrations and potential exposures are generally low, the environmental risks or public health significance of these background concentrations are considered minimal.

## SUMMARY AND CONCLUSIONS

- The pesticide monitoring program conducted in PEI over the three-year period (2003 – 2005) was a major step toward meeting the national and provincial objectives of determining the presence, concentrations and potential risks of pesticides in the environment in PEI and generating new information on the environmental fate of these products in the natural environment.

- Detections of pesticides in groundwater were relatively rare. Where pesticides were detected, the concentrations were quite low in comparison to the drinking water guidelines established to protect human health. However, the presence of pesticide residue in groundwater, in a province that relies on groundwater for its drinking water, highlights the need for continued monitoring.

- Pesticide residues were detected in 14 of the 82 samples collected from six different water systems over the three-year sampling period. Chlorothalonil exceeded its *Canadian Water Quality Guideline for the Protection of Aquatic Life* on two occasions. There is no Canadian guideline for hexazinone. However, this pesticide was found to exceed Germany's water quality target on four occasions. Pesticide detections above Canadian guidelines or German water quality targets represent a potential risk to the aquatic environment.

- With respect to pesticides found in stream sediments, it is evident that certain products, particularly those that have a tendency to bind to soil particles, are present in sediment. This supports the need for expanded research on the acute and chronic impact of these products on insects and other aquatic life that live in or on streambeds. The data also supports the need for the development of additional sediment quality guidelines in Canada.

- The finfish and shellfish tissues analyzed as part of this monitoring program did not show the presence of any pesticide residues.
- With respect to the monitoring of pesticides in ambient air in an intensive agricultural region of the province, there were a significant number of detections in both the 2003 and 2004 samples. While many of the pesticides detected are used locally, others such as chlordane and lindane) have not been used in this region for several years and would indicate that these pesticides are being carried to this area by weather patterns. All detections were well below international air quality guidelines.

## Work Continues

The Province of PEI and Environment Canada are continuing to carry out pesticide monitoring activities in Prince Edward Island through an ongoing partnership. The focus in 2006 was on the groundwater and surface water monitoring programs. Because there were no pesticide detections in the finfish and shellfish monitoring over the last three years, that part of the monitoring program has been suspended for now. The ambient air monitoring has also ended. However, pesticide concentrations in air continue to be studied under near-field conditions through an ongoing research project. Sediment sampling was not conducted in 2006. However, sediment sampling resumed in 2007.

Further details on pesticide research and monitoring activities can be found at

**www.gov.pe.ca/go/pesticideresearchandmonitoring**

or by calling the PEI Department of Environment, Energy and Forestry at (902) 368-5000
or Environment Canada, at (902) 566-7043.